Migros Cross-Math Solver

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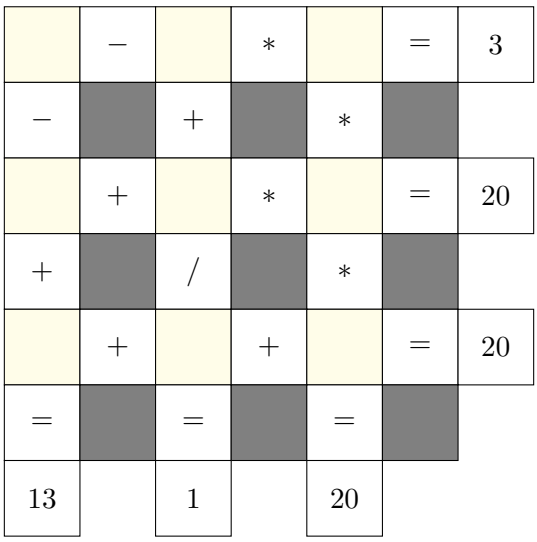
1 Problem

The Cross-Math puzzle is a puzzle with 9 numbers to fill. The rules are simple:

- Mathematical operation ordering does not count, simply calc from left to right and from top to bottom
- Each cell is filled with a number between 1 - 9
- Each number can only appear once

The puzzle presented is the following:



2 Mathematical formulation

$$
\begin{array}{lllll}
\min & 0 & & & (1)\\
\text{s.t.} & x_i & \geq 1, & \forall i \in \{1,\dots,9\} & (2)\\
 & x_i & \leq 9, & \forall i \in \{1,\dots,9\} & (3)\\
 & x_i - x_j & \leq -\epsilon + y_{i,j}M, & \forall i,j \in \{1,\dots,9\} & (4)\\
 & x_i - x_j & \geq \epsilon - (1-y_{i,j})M, & \forall i,j \in \{1,\dots,9\} & (5)\\
 & (x_0 - x_1)x_2 & = 3 & & (6)\\
 & (x_3 + x_4)x_5 & = 20 & & (7)\\
 & x_6 + x_7 + x_8 & = 20 & & (8)\\
 & x_0 - x_3 + x_6 & = 13 & & (9)\\
 & \dfrac{(x_1 + x_4)}{x_7} & = 1 & & (10)\\
 & x_2 x_5 x_8 & = 20 & & (11)\\
 & x_i & \in \mathbb{N}, i & \forall i \in \{1,\dots,9\} & (12)\\
 & y_{i,j} & \in 0,1,i & \forall i,j \in \{1,\dots,9\} & (13)\\
 & & & & (14)
\end{array}
$$

M is very big and ϵ is a very small number.

Equation 2 to Equation 5 are the basic requirements for the corss-math puzzle. Equation 6 to Equation 11 are the specific equations for this problem.

3 Solution

9	−	6	∗	1	=	3
−		+		∗		
3	+	2	∗	4	=	20
+		/		∗		
7	+	8	+	5	=	20
=		=		=		
13		1		20		